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logued, including the important volumes, the Books of Lecan and Ballymote, whose examination would take some months, and that the Council have therefore been under the necessity of applying to the Academy for a further grant of money to enable Mr. Curry to complete the work.

It was resolved by the Academy that the sum recommended by the Council be granted for this purpose.

December 11.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Matthew Dease, Esq., William M'Doughall, Esq., Sir Montague Chapman, Bart., James H. Pickford, M.D., Edward Bewley, M.D., and James S. Eiffe, Esqrs., were elected Members of the Academy.

Professor Kane read a paper on the Chemical Composition of the plants of Flax and Hemp.

In those plants which are cultivated for the purpose of being ultimately employed as food, it is found that certain constituents are withdrawn from the soil, partly of an organic and partly of an inorganic character, which give to the plant, or to certain portions of it, the constitution that adapts it for sustaining the animal organism. Thus nitrogen, alkalies, and lastly, phosphates, &c., are found as components of plants, and the value of the crop yielded by a certain surface of ground is proportional, generally speaking, to the materials which the crop has taken up. If, therefore, wheat, or oats, or potatoes exhaust a soil, the agriculturist does not suffer thereby, for he is paid for the materials of which they have exhausted it, and when he replaces that loss of material by fresh manure he but invests a certain capital, to be delivered at a profit in the next season.

Many plants not employed as food, but ancillary to our civilization as luxuries, or as utilized in the arts, are similarly circumstanced. Thus when indigo or tobacco is grown, the object is to obtain the greatest possible development of the colouring or of the narcotic principle. For this purpose, elements are necessary of which the soil is thereby deprived, but the impoverishing of the soil is paid for, by its materials being sold as the valuable portion of the plant. In such cases, therefore, to sustain the fertility of the soil, a continued supply, from external sources, of the materials which the plants take up is required. The farmer must supply in the manure the elements which he sends to market in the grown plants.

Dr. Kane then proceeded to point out that this principle was limited as to certain classes of plants, by the fact, now clearly established by the concurrent investigations of vegetable physiologists and of chemists, that certain vegetable substances, and those of high importance to mankind, were not formed of materials abstracted from the soil, but were produced by the vital action of the plant upon the constituents of the atmosphere. This class of bodies he characterized as being constituted, generally, of carbon, united with hydrogen and oxygen in the proportions which form water. The carbonic acid of the atmosphere, with the watery vapour constantly existing in it, supplies the elements of sugar, gum, starch, and ligneous fibre, and the oxygen of the carbonic acid, evolved by the vital action of the plants, tends, as it is well known, to ameliorate the air we breathe. When, therefore, we take the sugar, or the woody fibre of a plant, we have a material, formed, as to its elements, independent of the soil. For its formation is required a plant in healthy vegetation, and for the plant to be in healthy vegetation, it may require to abstract from the soil various materials, so that the crop may actually be of a highly exhausting nature. Still those materials do not go to the sugar or to the fibre; they exist in other portions of the plant; and if the sugar or fibre be the valuable portion of the crop, as in reality usually occurs, the elements which render its production costly are rejected, and let to waste; they do not subserve any future useful purpose, although nothing should be easier than to apply them thereto.

Such is actually, according to Dr. Kane's idea, the condition of the growth of one plant of the highest importance to agricultural industry in Ireland—that of flax, and also of another, which although not now grown here, has been grown with success, and, as he conceives, might still be cultivated with considerable advantage, the hemp. In flax and hemp the valuable portion of the plant is ligneous fibre; the purer this fibre is, the more its value increases; yet the pure fibre contains no element derived from the soil. It is well known to be produced solely by the atmospherical constituents. Hence the intense exhausting nature of the flax and hemp crops, which makes them be dreaded by agriculturists, notwithstanding the high money value of the crops, arises, according to Dr. Kane, from causes of which the effects may be obviated by attention to the true conditions of the growth and composition of the plants, so that those fibre-crops, such as flax and hemp, from being the most exhausting and expensive, may be rendered the least injurious to the land, and perhaps amongst the cheapest that can be grown.

As the chemical composition of these plants had never been examined, Dr. Kane devoted himself to the determination, as well of their organic as of their inorganic constituents, and from an extensive series of analyses, of which the details are given in the memoir, arrived at the following results:

Composition of the stem of hemp, dried at 212°. F.

Carbon	39.94
Hydrogen	5.06
Oxygen	48.72
Nitrogen	1.74
Ashes	4.54
	100.00

Composition of the leaves of hemp, dried at 212°.

Carbon	40.50
Hydrogen	5.98
Nitrogen	1.82
Oxygen	29.70
Ashes	22.00
	100.00

The ashes of the hemp plant were found to consist of

Potash	7.48
Soda	.72
Lime	42.05
Magnesia	4.88
Alumina	.37
Silica	6.75
Phosphoric acid	3.22
Sulphuric acid	1.10
Chlorine	1.53
Carbonic acid	31.90
	100.00

Dressed hemp fibre was found to give but 1.4 per cent. of ashes, when dried at 212°. Its organic composition need not be given, as it is identical with that of ordinary woody fibre, which is well known. It therefore contains no nitrogen.

The characteristic constituents of the hemp plant are seen to be nitrogen and lime. In these it is peculiarly rich, and with these it is the duty of the agriculturist abundantly to supply it.

When hemp is steeped in order to separate the fibrous bark from the internal stem, it is known that the water dissolves certain substances out of the plants, and thereby acquires narcotic properties. Dr. Kane evaporated a quantity of the hemp liquor to dryness, and analyzed the extract so obtained, in order to trace what action the steeping had exerted on the plant. He found the composition of the hemp extract, dried at 212°, to be,

Carbon	28.28
Hydrogen	4.16
Nitrogen	3.28
Oxygen	15.08
Ashes	49.20
	100.00

If we exclude the ashes, the organic part consisted of

Carbon	55.66
Hydrogen	8.21
Nitrogen	6.45
Oxygen	29.68
	100.00

This composition approaches to that of the azotized animal substances, and surpasses the animal manures usually sold. The water in which hemp has been steeped contains thus most of the nitrogen of the plant, and if poured over the soil should serve efficiently to restore its fertile powers.

The ashes of the hemp extract require also to be noticed, for the plant, in steeping, gives up to the water especially its soluble constituents. The ashes of the leaves of hemp contain in 22 parts only 1.77 soluble in water, or 8.05 per cent., whilst the ashes of the hemp extract contain in 49.2 parts, 29.70 parts soluble in water, or 60.4 per cent. Thus almost all the alkaline constituents of the ashes are dissolved out by the water, whilst the earthy materials remain associated with the residual portions of the stem.

Dr. Kane next examined the stem, as it remains after treatment for the fibre, by steeping and peeling. Dried at 212° this *hemp residue* consisted of

Carbon	56.80
Hydrogen	6.48
Nitrogen	.43
Oxygen	34.52
Ashes	1.77
	100.00

The ashes contained but a trace of alkali, and it is seen that the nitrogen has almost disappeared.

From these researches it is plain that, by the quantity of nitrogen, of phosphoric acid, of potash, of magnesia, and of lime, which the hemp takes from the soil, it must be, as experience proves it, a highly exhausting crop; but as the materials so abstracted are not found in the valuable fibre, but in the residual stem, the chaff, and the steeping liquor, all these are available for the purpose of restoring to the soil what had been taken up, and in fact, if it were possible to carry on the processes of the preparation of the fibre without loss, the same nitrogen and inorganic constituents might, as it would appear from these chemical inquiries and from physiological researches, serve for any number of successive crops of hemp; the fibre alone, generated at the expense of the atmosphere, being sent out and sold, and thus the crop be absolutely deprived of all exhausting quality to the soil.

Dr. Kane's inquiries regarding the flax plant were of a precisely similar character to those described already in the case of hemp, and have led him to similar conclusions affecting the practical culture of this important plant. The general results of his analyses are as follows:

Stem of flax dried at 212°; the plant had its usual amount of leaves, but the seed vessels had not ripened.

Carbon	38.72
Hydrogen	7.33
Nitrogen	.56
Oxygen	48.39
Ashes	5.00
	100.00

There is a great difference here shewn between the composition of the plants of hemp and flax, though they resemble each other so much in their uses. The hemp contains a large amount of nitrogen, the flax very little. The hemp contains more oxygen than would form water with the hydrogen. Flax, on the contrary, contains an excess of hydrogen. The difference is also remarkable in the composition of the ashes.

The ashes of the flax plant consist of

Potash	9.78
Soda	9.82
Lime	12.33
Magnesia	7.79
Alumina	6.08
Silica	21.35
Phosphoric acid	10.84
Sulphuric acid	2.65
Chlorine	2.41
Carbonic acid	16.95
	100.00

The great quantity of lime which characterized the hemp here disappears, and the peculiar quality of the ash is the presence of soda and potash in equal quantities, much magnesia, and especially the large proportion of phosphoric acid. Dr. Kane has not met with any analysis of the ash of a plant yielding the same amount of phosphoric acid, and hence the exceedingly exhausting power of the flax crop is easily understood.

Dr. Kane notices in this ash of flax, that the potash, soda, sulphuric acid, and chlorine are in a very simple relation to each other, the numbers given above coinciding closely with those of two atoms each of sulphuric acid and chlorine, six of potash, and nine of soda. So that if (in the ash) all the soda be taken as carbonate, the potash will be divided equally among sulphuric, muriatic, and carbonic acids. Dr. Kane thinks that this simplicity is probably accidental, but suggests it for attention in subsequent analyses of flax ashes from other localities.

The steeping of flax to loosen the coat of fibrous bark is accompanied by the solution of certain constituents of the plant, as in the case of hemp. The extract of the steeping water was analyzed; it yielded, dried at 212°,

Carbon	30.69
Hydrogen	4.24
Nitrogen	2.24
Oxygen	20.82
Ashes	42.01
	100.00

The organic part of this extract consisted therefore of

Carbon	52.93
Hydrogen	7.31
Nitrogen	3.86
Oxygen	35.90
	100.00

Here, as in the case of hemp, the nitrogen of the plant is concentrated, but the total quantity of nitrogen is not half so great. In the ash of the extract, as in the case of hemp, the soluble alkaline matters also preponderate. The ashes of the plant yielded 33.90 per cent. of matters soluble in water; whilst the ashes of the flax-steep extract yield 60 per cent. of matters soluble in water. The flax-steep is therefore rich in all the materials necessary to produce a new generation of plants; and Dr. Kane stated, as a satisfactory confirmation of the views put forward in his memoir, that in many instances where agriculturists have sprinkled land with the water in which flax has been steeped, they have found it a most active manure.

After the flax fibre has been removed from the rotted stem, the residue, or chaff, was found to be composed as follows:

Carbon	50.34
Hydrogen	7.33
Nitrogen	.24
Oxygen	40.52
Ashes	1.57
	100.00

This is almost identical in composition with the residual hemp stem, and may therefore be applied to the same uses. Restored to the soil with the steep water, it should give back all that the crop of flax had taken from the grounds, and thus the valuable fibre being generated by the atmosphere, the great source of expense in the cultivation of the plant might be removed.

Dr. Kane finally placed before the Academy certain tables, in which, taking the average quantity of produce from a statute acre of fibre-crops and of food crops, and comparing, from the data supplied by the analyses of Sprengel, Boussingault, and his own, the weights of materials of which the soil is exhausted by each crop, it appeared that the fibre crops were actually more exhausting than the food crops; whilst the agriculturist profits by the materials that the food crops take out of the ground, and the substances taken up by the fibre crops from the soil are at present actually rejected as waste and valueless. Hence it is, as Dr. Kane considers, of much interest to the agricultural industry of Ireland that the views of economizing the residues of the preparation of flax and hemp, put forward in his memoir, be tested by practical men, as, if they be found correct, and that those residues may be applied with success to prepare and fit the soil for another crop, those fibrous plants will be practically deprived of their exhausting qualities, and the greatest disadvantage, under which their extensive cultivation in this country labours, may be removed.